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SOME PHASES OF COAL EXTRUSION IN USSR COAL MINES

[Coal extrusion -- a pushing out, bulging, or even breaking loose of coal in an uncovered coal seam -- is caused by internal seam pressure.]

COAL EXTRUSION IN THE KARAGANDA BASIN -- Moscow, Ugol', No 10, 1953

The phenomenon of coal extrusion at the face is encountered in the working of most coal seams in the Karaganda basin. The size and characteristics of the extrusion, which differ in the case of different seams, are more intense for thick seams such as the Verkhnyaya Marianna and Feliks, and less intense for medium thick seams such as Shestifutovyy, Zamechatel'nyy, Vyshesrednyy, and Dvoynoy.

In the top layer of the Verkhnyaya seam, where extraction by the slicing method is carried on, coal extrusion occurs before and, particularly after, the undercutting of the face. The extruding coal block reaches a width of 40-50 centimeters or more along the entire thickness of the seam. This coal becomes loose, slips suddenly away from the mass of the face, and falls in large lumps, accompanied by crackling sounds. The falling of the coal is dangerous to workers moving along the face and at the working front.

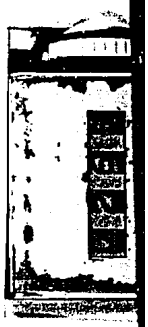
The danger of injury caused by coal extrusion is greater in the usual mechanized removal of the top layer of the Verkhnyaya Marianna than it is in extraction by "windows" and ledges. In the latter cases the exposure of the face is slight, and coal extrusion does not occur since it begins to appear only when the face extends in a straight line for a considerable distance.

Coal extrusion greatly lowers the efficiency of the extraction combine since the working units of the machine were designed without taking it into account. Observations during tests of a double Donbass combine which was removing the top layer of the Verkhnyaya Marianna seam indicated the following: The machine was idle 18.3 percent of the entire length of the cycle because it was necessary to clear the extruded coal from the passageway. The operation of the combine was further hampered because it was necessary to knock loose rock from the face and to insert props to prevent collapse of the extruding coal.

In other seams of the basin, coal extraction with regular Donbass combines predominates. Coal extrusion starts to appear shortly after the combine passes, but the width of the extruding mass is somewhat less here, amounting to 10-25 centimeters. In distinction to the Verkhnyaya Marianna and the Feliks seams, the extrusion process proceeds gradually and the coal falls in small lumps.

Extrusion of coal in these circumstances, although not dangerous, still reduces the efficiency of operation of the regular combines since the volume of manual labor in trimming the extruding mass is increased. In the case of soft coals extrusion is so great that the combine is virtually idle and only evens off the coal mass of the face.

The mines of the Karaganda basin, worked by mechanized coal extraction, also are subject to coal extrusion. Two methods of protecting against the collapse of extruded coal have received wide application: In one, a third post is set up in the framework prop beside the coal face; in the other, a brace is inserted against the coal face.



Neither method, however, has eliminated the phenomenon of coal extrusion but has only contributed to protecting the workers from injury. In addition to this, the organization of work at the face is complicated, consumption of mine timbers is increased, and danger during operations is not completely excluded. The installation of a brace in the coal face encumbers the machine passageway, and the setting up of a third prop does not eliminate the possibility of the collapse of the coal and injury to the workers.

A method for combating coal extrusion under conditions prevailing in Mine No 20 of the Karagandaugol' Combine has been proposed. This method consists in giving to the surface of the coal face a sloping position corresponding to the angle of stable slope. It is known that, after coal extrusion, the surface of the coal mass assumes a /sloping/ position which practically eliminates further extrusion and which is therefore /a stable slope/. The angle of stable slope can be determined by direct measurements. To give the surface of the coal mass the required slope, it is necessary to increase the depth of the upper boreholes to the determined size and to reduce the depth of lower boreholes correspondingly. Then, after blasting, the surface of the coal mass assumes the required sloping position, which excludes coal extrusion.

Starting in 1952 this method was used at all faces in the upper layer of the Verkhnyaya Marianna seam. At present, working units of combines give the surface of the coal face a vertical position. If this working unit is shaped so as to impart to the surface of the face a sloping position corresponding to the angle of stable slope, the work of the combine will eliminate extrustion.

FACTORS DETERMINING COAL EXTRUSION IN DONBASS SEAM l_3 -- Moscow, Ugol' No 10, 1953

Mine No 17/18 of the Krasnoarmeyskugol' Trust of the Stalinugol' Combine is working seam l_3 of the S^6_2 series. The angle of dip of the seam is 10-12 degrees, the total thickness 1.59-2.52 meters, and the working thickness, 1.19-1.86 meters.

The structure of the seam is complicated, consisting of eight interlayers of coal and rock of varying thickness. The coal in the seam is moderately tough, with intrusions of calcite, more rarely of pyrite, and with lenses and nodules of sulfur pyrite. The cleavage of the coal is sharply distinguished, its line of direction forming an angle of about 60 degrees with the line of the faces (15th southern and 15th northern). The angle formed by the cleavage fissures and a horizontal plan is 85 degrees and the distance between cleavage fissures is 0.12, 0.16, and 0.20 meter.

The coal is type G_K. The mine belongs to category 1 from the standpoint of gassiness /mines in which not more than 5 cubic meters of methane are liberated per ton of daily output/. The coal in seam l_3 is not watery. It contains only natural moisture except in places where it received a little water from the roof.

The immediate roof of seam l_3 consists of a clayey shale layer 2-7 meters thick, monolithic, friable, and with inclusions of silicon-clayey nodules and carbonaceous substance along the layer. Above the clayey shale lies sandy clayey shale and shaley sandstones, very compact, moderately tough, slightly fissured, and slightly crumbling but stable.

Seam l_3 is being worked by long pillars along the strike with coal removal from the extreme limit of the section. The coal is cut by the KMP-1 cutting machine with the useful depth of the cut 1.65 meters. Coal is broken up by explosives and is conveyed along the face by SKR_2-11 scraper conveyers.

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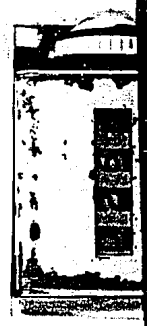

Roof control is effected by partial backfilling of the worked-out area, approximately 70 percent. The face is propped by wooden props, whereas organ-pipe props are used along the conveyer line. The width of the working area before removal of coal is 2 meters, and after, 4 meters.

Mining is carried out in two shifts, with the third shift devoted to repair and development work.

Extrusion of coal is observed at all coal faces when seam l_3 is exposed. In this connection the stability of the coal is considerably decreased, and it separates off in layers along the cleavage fissures.

The degree of coal extrusion at mine faces in seam l_3 depends on a number of mine geological and mine technical conditions, chief among which are the following:

1. The size of the horizontal angle between the line of the face and the line of direction of the cleavage fissures in the coal and rock of the roof. -- Here it is possible to establish a direct dependence: The less this angle (the more acute), the more intense the extrusion and the deeper the zone of extrusion.

2. The firmness of the side rock and of the coal seam as well as the structure and thickness of the seam. -- Coal extrusion in seam l_3, which has a complicated structure, takes a different form in different blocks of coal. The most intensive break and shift of the coal is observed in the second coal block, which lies on a firm interlayer of sandy shale. The least extrusion is in the first block, which is explained by the weak immediate roof of seam l_3.

3. Tectonic disturbances. -- Tectonic disturbances, including a slight narrowing and shifting of the seam which disturbs the uniformity of mine pressure, slow up the process of extrusion. At faces where such disturbances are present extrusion appears relatively slight.

4. Firmness and rigidity of propping. -- The firmer and more rigid the propping, the less the extrusion. The considerable disturbance in the roof and the intense development in cleavage cracks in section No 5 of Mine No 17/18 made it necessary to set up reinforced props (organ pipe) at the 15th southern and 15th northern faces, the surface of which make acute angles with the line of direction of the coal cleavage.

5. Speed of advance of the face. -- Coal extrusion proceeds more intensely in slowly advancing coal faces.

6. Width of the working area. -- Observations indicate that coal extrusion is less intense at faces with working areas of minimum width (2 meters); and more intense at faces with wider working areas.

7. Compactness of backfilling. -- The worse the backfilling of the worked-out area, the more intense the coal extrusion. Coal extrusion at faces seems most intense after roof caving.

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